WRA Bulletin 59

January 2021

UK WORK

Operational Control of Discharge at Tyle Mill

WRA was hired to investigate oscillatory water level fluctuations observed between Tyle Mill and Theale flow gauging station on the River Kennet in Berkshire, and how hydraulic structures at the mill might be managed to maintain a more natural flow when the river is not in flood. Partners Paul Holmes and Frank Farquharson, with Associate Dave Carless, were involved in this study.

Old Evershed Noflote electrodes monitoring water level

The 60-year record at Theale includes continuous water level data for the past 35 years, which was analysed to investigate oscillatory characteristics and the impact of sluice-gate operation. The results showed that regular sinusoidal oscillations of 10-30 mm amplitude were present throughout the record, which were presumably acceptable to other users of the river.

Oscillations caused by Tyle Mill probably date back to 1914-1937, when the sluice gate control system was installed. Since 2015, these oscillations increased in magnitude to a 40-80 mm range, most likely in response to a change in the upstream water level regime probably arising from operations at Padworth Mill. As a result, the system installed at Tyle Mill could no longer cope with the rate of change in upstream water levels. Oscillations in the historical record were essentially absent at times of low flow, when Theale stage readings fall below 0.31 m on the staff gauge.

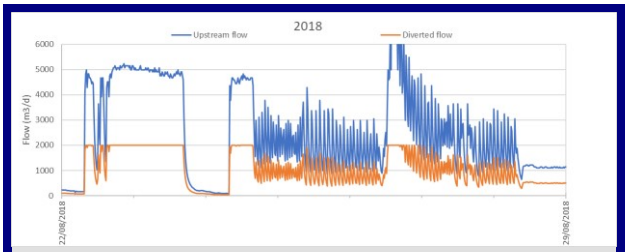
All of the electromechanical elements of the existing system were concluded to be fit-for-purpose, but the Noflote electrodes and electronics control unit would be replaced, to allow continuous monitoring of upstream water level. A sensor would also be fitted to one of the gates to monitor the gate position precisely. Once programmed and installed, the new PLC-based system would be fine-tuned by adjusting the PID feed-back parameters to optimise the responsiveness of the system, while adjusting out the hunting. Water level would be fed continuously to the PID controller and averaged to avoid rapid alternations of gate movement, assuming a dead zone of around 5 mm on either side of the target water level.

[Key: PLC, Programmable Logic Controller; PID, Proportional-Integral-Derivative].

Grand Western Canal, Devon

Since March 2020, Associate Marcus Francis has been supporting Devon County Council [DCC] and providing technical advice relating to the Fenacre Water Diversion Scheme, which diverts water from Fenacre Water into the Grand Western Canal. This has involved mediating the interests of DCC, Environment Agency [EA] and Aggregate Industries, the owners of Westleigh Quarry.

During quarrying and dewatering, the canal lost inflow from the Carboniferous limestone in the quarry through reversal of groundwater flow direction in this area, with the local groundwater level now some 30m below the bed of the canal; consequently the canal began to recharge the aquifer. The concept of using dewatering dates back to 1994, and was implemented using a S106 Agreement under the Town and Country Planning Act 1990. It could have been implemented via a direct pipeline from the quarry but regulation of flows in Fenacre Water provides benefits to the river and is more cost-effective. However the diversion scheme as implemented is ineffective.



Sample of Fenacre Water summer flows at the point of diversion

In 2019, the approach considered was abstraction linked directly to flow in river, with hands-off-flow, but this provides little or no compensation in the critical summer months. In 2020, the EA accepted that both the natural watercourse (Fenacre Water} and the canal have been impacted by quarry dewatering and that a proportional division could be developed. Wood plc are charged by Aggregate Industries with the re-design of the diversion works for implementation. The design will be subject to review and confirmation by the EA and DCC, supported by Marcus Francis.

OVERSEAS WORK

NEPA Decision Support System, Jamaica

Paul Holmes lead a WRA-NTEK joint venture, involving staff from NTEK Design Solutions Inc., ISLAND Group, and University of West Indies. They developed a new web-based GIS and Decision Support System [DSS] for Integrated Watershed Management [IWM] of the Yallahs and Hope River basins in south-east Jamaica. These rivers provide a large proportion of Kingston city water supply, and are also the home of Blue Mountain coffee production. The remainder of the city water supply is sourced from the Wagwater River, Rio Cobre and groundwater. The project was the final part of a five-year Inter-American Development Bank [IDB] investment programme aimed at reversing land degradation and improving water management.

Watershed Management Units in Jamaica, with Yallahs & Hope highlighted in yellow

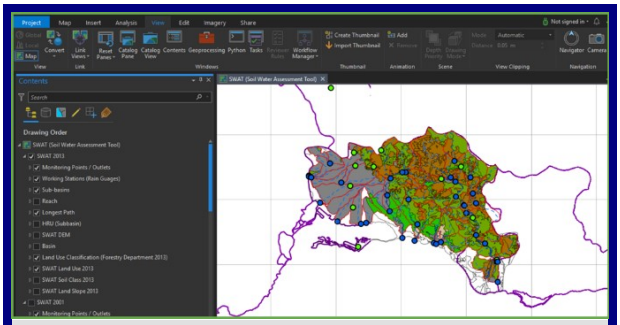
In the light of a growing population, land-use changes for fruit and coffee cultivation, and potential growth in irrigation demand, an integrated and more refined approach was required to enable all stakeholders of this region to effectively and interactively manage all interests and the long-term environmental and economic sustainability of local resources and development activities.

IWM-GIS-DSS Home page

NEPA [National Environment and Planning Agency] was responsible for overall project coordination and management, through collaboration with the Jamaican Water Resources Authority, Forestry Department, National Water Commission, Meteorological Services, Jamaica Conservation and Development Trust, Rural Agricultural Development Authority, local authorities and community interests.

The assignment carried out design, development, training and operation of the new IWM-GIS-DSS software solution. It involved use of ArcGIS developer and python programming to integrate model platforms with agency data, using a central geodatabase, graphical user interface [GUI], and information distribution protocols configured to archive and present preformatted datasets to multiple and diverse end-users.

The system is web-enabled so that users can update and access the DSS application to facilitate analysis, process modelling decision making, and hydrological forecasting. It is also capable of integrating models from hydrology, economics, and ecology with GIS, providing a common framework for database management and visualization.



Impact of rainfall analysis and drought prediction

The DSS application was provided with Quick Start and User guides. So far, over 100 staff from the client and stakeholder membership have attended training courses run for separate groups of users and administrators. The system was operated by WRA until December 2020, with further enhancements planned. The system has demonstrated, as a case study, the hydrological impact of deforestation and land-use change on city water supply. This work was undertaken in conjunction with a post-doctoral thesis at the University of the West Indies Kingston campus.

. Data Management and Publishing Dashboard

Next WRA Board Meeting

Tuesday 20th April 2021, connecting by Zoom

The WRA Bulletin is a quarterly publication, and relies on contributions submitted by Partners, Associates and Consultants. The document is circulated by email, and published on the WRA web-site, aiming to keep the WRA network up-to-date with respect to current activities. Please email contributions for future issues to Nick Mandeville: nick@watres.com

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